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CAE-SCRUB for Incorporating Static Analysis into Peer Reviews

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What is CAE-SCRUB?

- **C**omputer **A**ided **E**ngineering-**S**ource **C**ode **R**eview **U**ser **B**rowser
- Peer review tool for static code analysis
  - Originally developed by Gerard Holzmann of JPL's Laboratory for Reliable Software
  - Currently maintained by JPL's CAE group and Software Quality Assurance (SQA) group
- Used by many past and current JPL projects
  - Baseline version available to JPL projects that can be configured to meet project needs

The Value of CAE-SCRUB

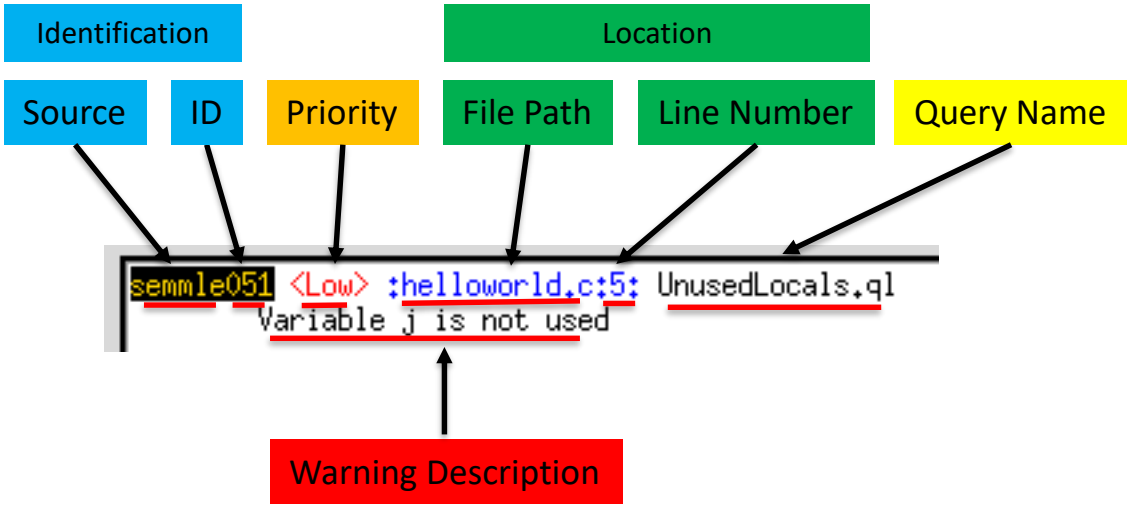
- Helps organize and guide the code review process
  - Aggregates and facilitates review of static code warnings
  - Captures and manages review comments
  - Allows developers and reviewers to concentrate on more contentious issues without neglecting code reviews
    - Combines effectiveness of peer reviews and total coverage of static analysis
- Integrates static code analysis reviews into the software development lifecycle by treating each static analyzer as a “peer” in code reviews

How it Works

- Use configuration information to invoke different static analyzers to examine source code
- Filter warnings based on the scope of the peer review
- Provide standardized results that can be reviewed using the GUI as part of a regular peer review
- Use GUI's review process to agree with, disagree with, and discuss all issues found by the analyzers and add generic peer review comments
- Review results trigger code changes to resolve issues

Standardization of Warnings

- A common format for displaying warnings
- Post-processing performs mapping from static analyzer format to CAE-SCRUB format



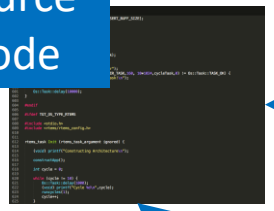
Evolution of CAE-SCRUB

- Inherited a very well establish version of SCRUB, but it was not suitable for large-scale deployment
- Refactored backend code
  - Improved architecture and stability
  - Simplified setup process via configuration file based setup
  - Improved error handling capabilities
- Improved installation guide and user guide
- Transitioned to git for version control

Architecture

Development Machine

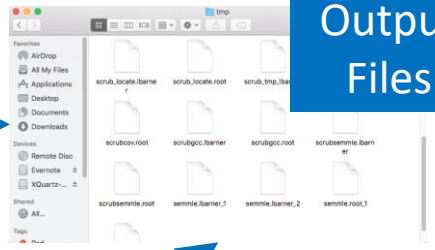
Source Code



Analyzes

Static Analyzers

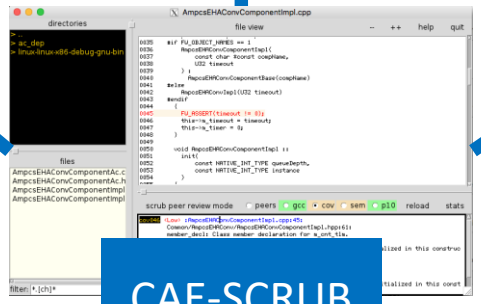
Creates



Output Files

Runs

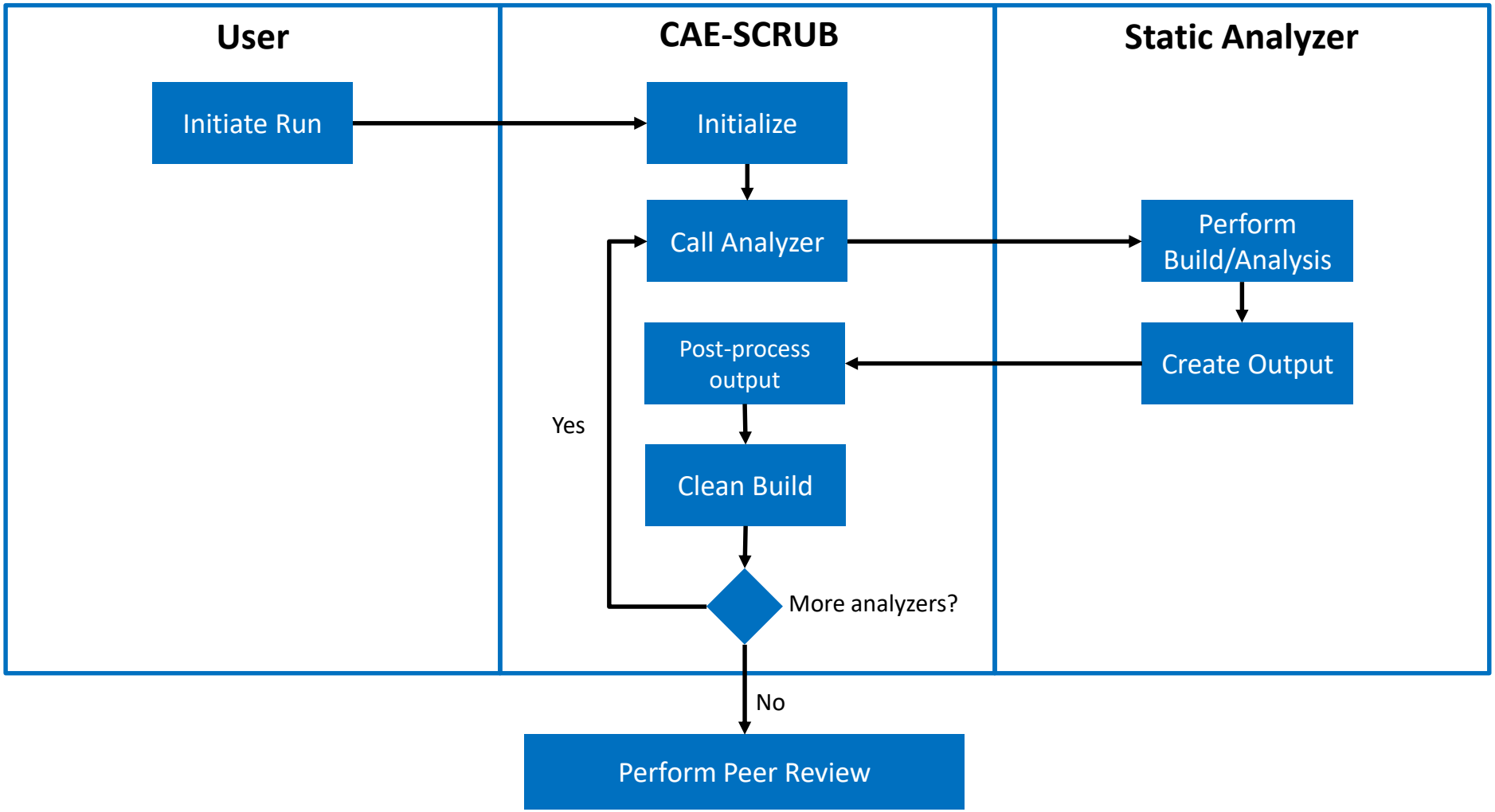
Reads



CAE-SCRUB

Reads

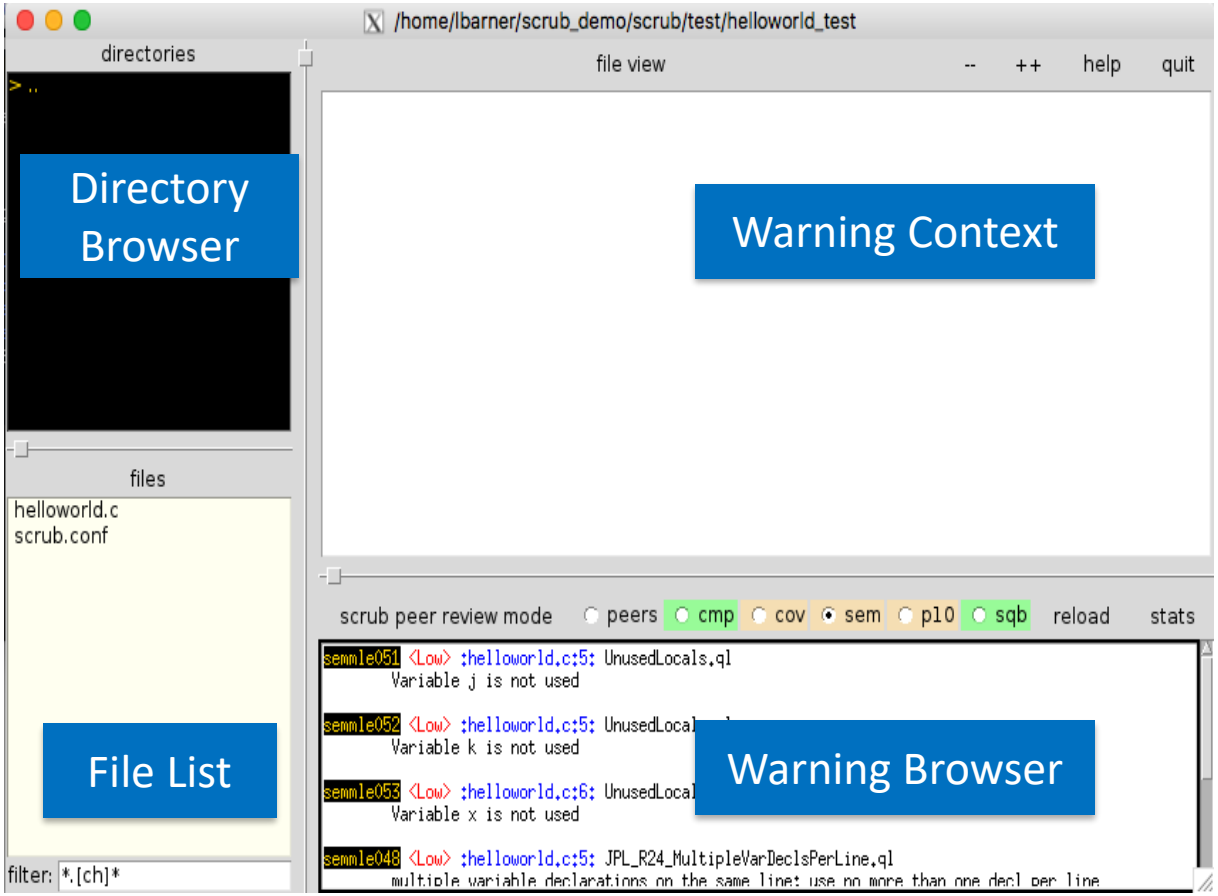
Program Flow



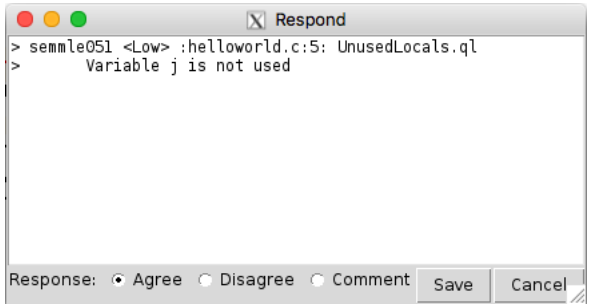
Typical Usage Example

1. CAE-SCRUB is run on desired revision/branch of source code
   - Either manually or via system automation
2. Peer reviewers are notified of new results
3. Reviewers Agree/Disagree/Discuss results asynchronously
4. Lead developer analyzes peer review results and organizes peer review if necessary
   a) Items where peer reviewers concur are not discussed
   b) Solutions are proposed where applicable
   c) False positives are noted and filtered out
5. Synchronous peer review is held to disposition remaining warnings

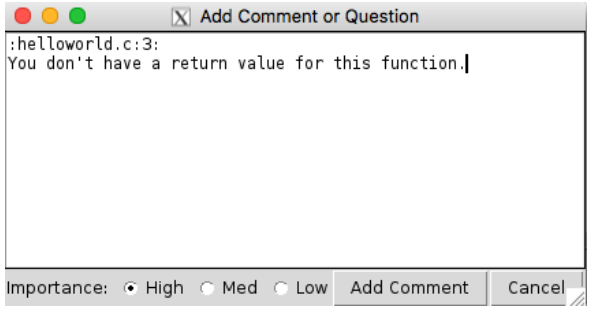
GUI Overview



Reviewer can see each warning in context to help with discussion and disposition



Reviewers "vote" and add/edit comments



Reviewers disposition each warning

Things CAE-SCRUB Does Well

- Provides a framework for static code analysis aggregation
- Provides a standardization of error types
- Streamlines the static analysis review process
- Implements a repeatable review process that can be integrated into development lifecycle

Areas for Improvement

- Difficult to deploy
  - Requires detailed knowledge of how to configure multiple static analyzers
- Currently no integration with CM tools
- Number of warnings can be overwhelming
- Quality of results is highly dependent upon configuration
- No severity ranking information

The Path Forward

- Investigate integration with other code review tools
  - Integration with COTS peer review tools can mitigate the need to maintain local deployments of CAE-SCRUB
- Create baseline set of queries to be run for each static analyzer
- Create ranking system for types of warnings
- General stability improvements for backend
- Customizable query lists for static analysis tools

Summary

- CAE-SCRUB is a tool for integrating static analysis results into the peer review process
- It creates an extensible framework for connecting with static analysis tools
- Extensive work has been done to make large-scale deployment a possibility
- Integration with other software engineering tools is a top priority going forward

Backup Slides

Current Areas of Investigation

- Integration with CM tools such as git
- Integration with continuous integration tools such as Jenkins
- Integration with code review tools such as Collaborator

Implementation

- Backend realization
  - Collection of bash scripts handle running the static analyzers
  - Collection of Python scripts handle post-processing of data from static analyzers
- Frontend GUI written in Tcl/Tk
  - Frontend handles viewing and commenting on the results from the static analyzers

What is Static Analysis?

- Identifies patterns in code that indicate refactoring opportunities to make code more maintainable
- Code reviews are not a feasible way to review millions of lines of code
- Provides automated checks against JPL coding standards and best practices
- Static analysis can perform verification, but not validation